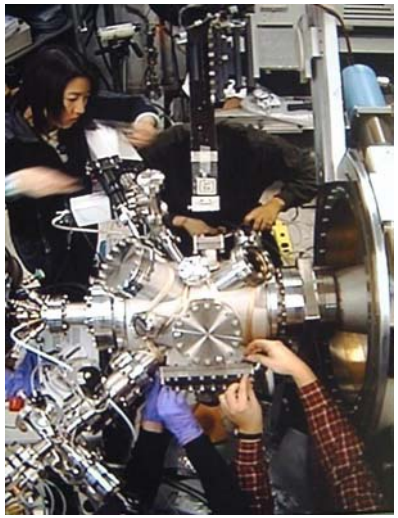
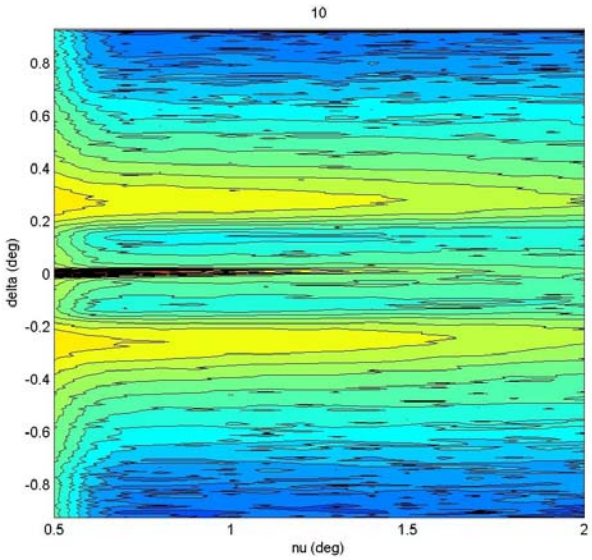
In-Situ X-ray Studies of Surface Structure During Plasma Processing

Karl Ludwig, Boston University

DMR-0208011



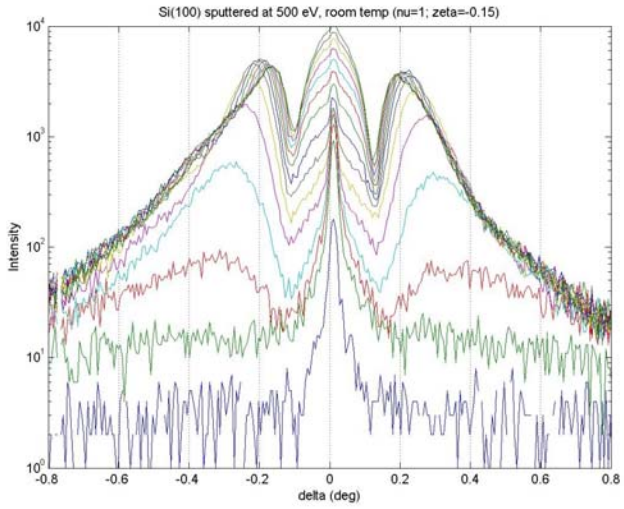
We are using intense x-rays from the National Synchrotron Light Source (NSLS) to examine how atoms on the surface of materials move during ion bombardment and plasma processing. X-ray scattering allows us to examine nanoscale structures on the surface as they form. To optimize our impact and capabilities, we are collaborating with Dr. C. Eddy of the Naval Research Laboratory and Prof. R. Headrick of the University of Vermont (UVM).



Top Right: BU and UVM students at work on the ultra-high vacuum x-ray scattering chamber.

Left: Complete x-ray intensity contours at one time during Ar^+ bombardment of Si(100) surface. The x-ray intensity shown examines structure perpendicular (x-axis) and parallel (y-axis) to the sample surface. The intense scattering in the yellow regions is due to 30-40 nm nanodot formation.

Right: Slices through data sets (such as shown on left) at consecutive 3 minute intervals during nanodot formation.



The diffractometer is installed on the insertion-device beamline X21 at the NSLS of Brookhaven National Laboratory on Long Island. The angle nu is perpendicular to the sample surface and delta is parallel to the surface. Using real-time x-ray diffraction we can examine how structures form spontaneously on the surface during processing.

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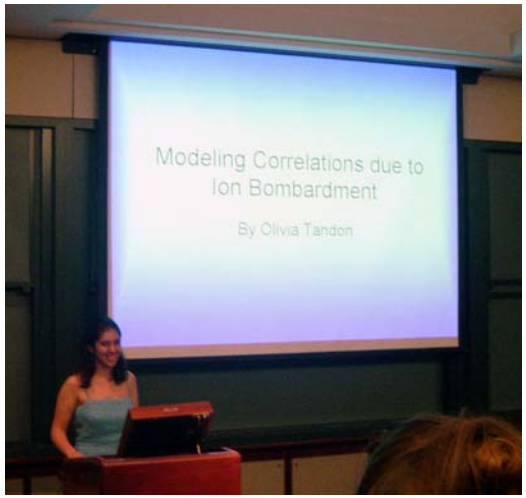
Education and Outreach:

Three graduate (Justin Hotchkiss, Gözde Ozaydin, Yiyi Wang) and one undergraduate student (Marta Szpilowska) have been contributing to the project this year. Marta helped assemble the ultra-high vacuum processing chamber and learned x-ray reflectivity. In Spring 2004, she graduated with her BA in Physics. Students have an excellent opportunity to learn about important materials technologies and to interact with scientists beyond their home academic institution.

During Summer 2004, we also introduced a student in the Boston University High School Honors Summer Research Internship Program (Olivia Tandon) to materials research. She helped do ion bombardment and plasma processing experiments and began investigating computer models of ion bombardment.

Above: Szpilowska, Ozaydin and postdoc Ahmet Ozcan with the processing chamber. Szpilowska graduated with her BA this year.

Below: High school student Olivia Tandon presents the results of her computer simulations.



The ultra-high vacuum (UHV) processing chamber is shown here in a clean room at Boston University. High School Intern Olivia Tandon learned how to do ion bombardment and plasma processing experiments. She also did computer simulations of surface evolution during ion bombardment that she presented to the other members of the internship program. It is planned that Olivia will continue working with the group for a few hours each week next year, her senior year in high school.